IS 10000-1 (1980): Method of tests for internal combustion engines, Part 1: Glossary of terms relating to test methods [TED 2: Automotive Primemovers]

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Indian Standard (Reaffirmed 2006)

METHODS OF TESTS FOR INTERNAL COMBUSTION ENGINES

PART I GLOSSARY OF TERMS RELATING TO TEST METHODS

1. Scope — Defines the terms generally used in connection with the testing of reciprocating internal combustion engines.

2. Reciprocating Internal Combustion Engines

2.1 *Compression Ignition Engine* — An engine in which ignition occurs by the temperature of the cylinder contents, resulting solely from their compression, delivering shaft power through one or more crankshafts.

2.2 *Spark Ignition Engine* — An engine in which ignition occurs by means of an electric spark.

2.3 *Free Piston Engine* — Mechanism delivering power by the combustion of fuel in one or more cylinders in which working pistons reciprocate, but are not mechanically constrained. The power is thus not transmitted by a shaft.

2.4 *Engine Speed* (n) — Mean rotational speed of its crankshaft or shafts in revolutions per minute (rev/min), except in the case of 'free piston' engines where the speed is the number of cycles per minute of the reciprocating components.

2.4.1 *Engine driving shaft speed* (n_d) — Mean rotational speed of the engine driving shaft in revolutions per minute (rev/min).

2.5 *Power* (P) — For the engines delivering power by shaft or shafts, any power in this standard is a quantity proportional to the mean torque calculated or measured, and to the mean rotational speed of the shaft or shafts transmitting this torque. The power shall be declared in killowatts (kW).

2.5.1 *Continuous power* (P_c) — Power which the engine is capable of delivering continuously, between the normal maintenance intervals stated by the manufacturer, at the stated speed and under the stated ambient conditions.

2.5.2 *Overload power* (P_o) — Power which an engine may be permitted to deliver, at stated ambient conditions, immediately after working at continuous power. An overload power of 110 percent of the continuous power shall be permitted for the purpose of testing according to Indian Standards [*see* IS : 10000 (Part IV)-1980 Declarations of power, efficiency, fuel consumption and lubricating oil consumption].

2.5.3 *Fuel stop power* (P_{fs}) — Power which an engine is capable of delivering during a stated period corresponding to its application and at stated speed and under stated ambient conditions, with the fuel limited so that the fuel stop power cannot be exceeded.

2.5.4 *Service power* (P_s) — Power determined under the ambient and operating conditions of an engine application.

Note — To determine service power, the following conditions may be taken into account:

a) the ambient conditions,
b) the normal duty of the engine,
c) the expected interval between the maintenance periods,
d) the nature and amount of attendance required, and
e) all information relevant to the operation of the engine in service [see IS : 10000 (Part VI)-1980 Recording of test results and IS : 10000 (Part XI)-1980 Information required with inquiry or order and information supplied by the manufacturer with the engine].

2.5.5 *Indicated power* (P_i) — Total power developed in the working cylinders by the gases on the combustion side of the working pistons.

2.5.6 *Brake power* (P_a) — The power or sum of the powers measured at the driving shaft or shafts.

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2.5.7 *Net power* (P_n) — The power obtained on a test bed at the crankshaft or its equivalent, at the engine speed specified by the manufacturer, the engine being fitted with all the equipment required, for particular vehicle/other applications, as listed in Appendix A of IS : 10000 (Part II)-1980 ' Standard reference conditions ' and with auxiliaries required (*see* Appendix A).

2.5.8 *Rated power* (P_r) — The power obtained on the test bed at the rated speed specified by the manufacturer.

2.6 *Engine Torque* (T_{tq}) — Mean torque measured in kNm at the engine driving shaft extremity.

2.7 *Load* — A term describing the magnitude of the ' power ' or ' torque ' demanded from the engine by its driven machinery and usually expressed relative to a declared power or torque.

Note — For quantitative purposes, the terms ' power ' or ' torque ' should be used, instead of ' load ' together with the statement of speed.

2.7.1 *Rated load* — The load recorded on the dynamometer corresponding to the rated power (*see* **2.5.8**) and speed (*see* **2.4**) of the engine.

2.8 *Compression Ratio* (ε_c) — The numerical value of the cylinder volume divided by the numerical value of the combustion space volume.

Note — All the values referred to or normally in the cold condition. If otherwise, the condition shall be stated.

2.9 *Fuel Consumption* (G_f) — The quantity of fuel consumed by an engine per unit of time at a stated power and under stated reference conditions. The quantity of liquid fuels should be expressed in mass units (kg).

2.9.1 *Specific fuel consumption* (g_f) — Fuel consumption per unit of power expressed in grams per kilowatt hour (g/kWh).

2.10 *Lubricating Oil Consumption* (G_{cyl}) — The quantity of lubricating oil consumed by an engine per unit of time, expressed in grams/seconds (g/s) or in litres/hour (l/h).

2.10.1 For variable speed engines, the lubricating oil consumption may also be expressed as a percentage of fuel consumption.

2.10.2 *Specific consumption of lubricating oil* (g_{cyl}) — The lubricating oil consumption per unit of power expressed in grams per kilowatt hour (g/kWh).

2.11 *Pressures*

2.11.1 *Compression pressure in a cylinder* (p_c) — The maximum pressure in the cylinder when no combustion takes place, at a specified speed expressed in kilopascals (kPa).

Note 1 — For spark ignition engines, the spark plug shall be disconnected while measuring the compression pressure.

Note 2 — For compression ignition engines, the injectors shall be removed while measuring the compression pressure.

2.11.2 *Brake mean effective pressure* (p_{me}) — The ratio of the work done per working cycle corresponding to the brake power (*see* **2.5.6**), to the engine swept volume, expressed in kPa.

2.11.3 *Maximum pressure in a cylinder* (p_{max}) — The maximum combustion pressure in a cylinder, expressed in kPa.

2.11.4 *Intake air depression* ($\triangle p_k$) — The mean pressure head below atmospheric (suction) existing in the intake manifold with the air cleaner fitted, expressed in kPa.

2.11.5 *Exhaust back pressure* (p_{eb}) — The mean static pressure head existing in the exhaust pipe of an engine test bed installation, measured at a point in the pipe 150 mm downstream from the outlet flange of the engine manifold, expressed in kPa.

2.11.6 *Coolant pressure* (p_{cool}) — The pressure at given points of the fluid cooling system, expressed in kPa.

2.11.7 *Lubricating oil pressure* (p_o) — The oil pressure at given points of the lubricating system (in individual circuits before and after filters, coolers, etc), expressed in kPa.

2.11.8 *Fuel pressure* (p_f) — The mean fuel pressure after the fuel supply pump, expressed in kPa.

2.12 *Temperatures*

2.12.1 *Air intake temperature* (T_a) — Ambient temperature, expressed in kelvin (K).

Note — Intake air temperature shall be measured at a distance of 150 mm from the air intake. If a filter is provided, the temperature shall be measured at a distance of 150 mm from the filter. Where air intake into the filter is from various directions, the mean of four readings taken from diametrically opposite points at equal distances shall be used. It shall be measured by a thermometer shielded from radiant heat.

2.12.2 *Exhaust gas temperature* (T_b) — The temperature of exhaust gases measured at a point in the exhaust pipe, 150 mm downstream from the outlet flange of the engine manifold, expressed in K.

2.12.3 *Coolant temperature* (T_{cool}) — The temperature(s) at given point(s) of the fluid cooling system, expressed in K.

2.12.4 *Lubricating oil temperature* (T_o) — The oil temperature(s) at given point(s) of the lubricating system(s), expressed in K.

2.13 *Auxiliaries* — Items of equipment fitted to the engine, which affect its final shaft output. There are auxiliaries which are necessary for the continuous or repeated use of the engine.

2.13.1 *Dependent auxiliary* — An item of equipment, presence or absence of which affects the final shaft output of the engine.

2.13.2 *Independent auxiliary* — An item of equipment which uses power supplied from a source other than the engine.

2.13.3 *Essential auxiliary* — An item of equipment which is essential for the continued or repeated use of the engine.

2.13.4 *Non-essential auxiliary* — An item of equipment which is not essential for the continued or repeated use of the engine.

Note — Items of equipment fitted to the engine and without which the engine can not in any circumstance operate at its declared power are considered to be engine components and are not, therefore, classed as auxiliaries. Examples of typical auxiliaries are given in Appendix A for guidance only.

2.14. *Type tests* — These are the tests carried out on the new or modified engine design to establish its reliability and its performance during operation.

2.14.1 The type tests for constant speed engines are:

a) Preliminary run [*see* IS : 10000 (Part V)-1980 Preparation for tests and measurements for wear],

b) Initial performance test [*see* IS : 10000 (Part VIII)-1980 Performance tests],

c) Governing tests [*see* IS : 10000 (Part VII)-1980 Governing tests for constant speed engines and seiection of engines for use with electrical generators],

d) Endurance test [*see* IS : 10000 (Part IX)-1980 Endurance tests], and

e) Final performance tests [*see* IS : 10000 (Part VIII)-1980],

2.14.2 The type tests for variable speed engines are:

a) Preliminary run [*see* IS : 10000 (Part V)-1980],

b) Initial performance test [*see* IS : 10000 (Part VIII)-1980],

c) Speed limiter (or governor) check [*see* IS : 10000 (Part VIII)-1980],

d) Endurance tests [*see* IS : 10000 (Part IX)-1980], and

e) Final performance tests [*see* IS : 10000 (Part VIII)-1980].

2.15 *Acceptance Tests* — These tests are the production tests and are carried out on the engine to determine its power, fuel consumption and governing properties (wherever applicable) after its performance and reliability are established by type tests (*see* 2.14).

2.15.1 The acceptance tests for constant speed engines are:

a) Rating test [*see* IS : 10000 (Part VIII)-1980],

b) Fuel consumption test [*see* IS : 10000 (Part VIII)-1980], and

c) Governing test [*see* IS : 10000 (Part VII)-1980].

2.15.2 The acceptance tests for variable speed engines are:

a) Performance test [*see* IS : 10000 (Part VIII)-1980],

b) Speed limiter (or governor) check [*see* IS : 10000 (Part VII)-1980], and

c) Fuel consumption test [*see* IS : 10000 (Part VIII)-1980].

APPENDIX A

(*Clauses* 2.5.7 *and* 2.13.4)

EXAMPLES OF AUXILIARIES WHICH MAY BE FITTED DURING TEST

List A Essential Dependent Auxiliaries (*see* **2.13.1** and **2.13.3**)

1. Engine driven lubricating oil pressure pump
2. Engine driven lubricating oil scavenge pump for dry-sump engines
3. Engine driven engine cooling water pump
4. Engine driven raw water pump
5. Engine driven radiator cooling fan
6. Engine driven engine cooling fan for air-cooled engines
7. Engine driven fuel gas compressor
8. Engine driven fuel feed pump
9. Engine driven fuel pressure pump for common rail or servo-injection system
10. Engine driven scavenge air blower and/or charge air blower
11. Engine driven generator, air compressor or hydraulic pump when supplying power to items in List B, below
12. Engine driven cylinder lubricating pump
13. Air cleaner or air silencer (normal or special)
14. Exhaust silencer (normal or special)

List B Essential Independent Auxiliaries (*see* **2.13.2** and **2.13.3**)

1. Separately driven lubricating oil pressure pump
2. Separately driven lubricating oil scavenge pump for dry sump engines
3. Separately driven engine cooling water pump
4. Separately driven raw water pump
5. Separately driven radiator cooling fan
6. Separately driven engine cooling fan for air-cooled engines
7. Separately driven fuel gas compressor
8. Separately driven fuel feed pump
9. Separately driven fuel pressure pump for common rail or servo-injection system
10. Separately driven scavenge air blower and/or charge air blower
11. Separately driven crank case extractor fan
12. Separately driven cylinder lubricating pump
13. Governing or control system using power from an external source

List C Non-essential Dependent Auxiliaries (*see* **2.13.1** and **2.13.4**)

1. Engine driven starting air compressor
2. Engine driven generator, air compressor or hydraulic pump when supplying power to items not in list B
3. Engine driven bilge pump
4. Engine driven fire pump
5. Engine driven ventilation fan
6. Engine driven fuel transfer pump

EXPLANATORY NOTE

The testing and performance of constant speed and variable speed internal combustion engines was earlier covered by the following Indian Standards:

IS : 1600-1960 ' Code for type testing of constant speed internal combustion engines for general purposes ',

IS : 1601-1960 ' Performance of constant speed internal combustion engines for general purposes ',

IS : 1602-1960 ' Code for type testing of variable speed internal combustion engines for automative purposes ', and

IS : 1603-1960 ' Performance of variable speed internal combustion engines for automotive purposes '.

These standards were originally issued in the year 1960 and as a result of implemention of these standards by the manufacturers of engines and testing laboratories, as also the operation of ISI Certification Marking Scheme, these standards have now been extensively revised.

While IS : 1600 and IS : 1602 covered the codes for type testing of constant and variable speed engines respectively, the performance requirements of such engines were covered by IS : 1601 and IS : 1603, respectively. These standards are replaced by two sets of standards, one set covers the methods of testing of engines and the other covers the specification and performance requirements of both constant speed and variable speed engines.

The standard covering methods of tests is being published in following 12 parts (each part covering a particular test method or information related to methods of tests):

IS : 10000 Part I Glossary of terms relating to test methods

IS : 10000 Part II Standard reference conditions

IS : 10000 Part III Measurements for testing — units and limits of accuracy

IS : 10000 Part IV Declarations of power, efficiency, fuel consumption and lubricating oil consumption

IS : 10000 Part V Preparation for tests and measurements for wear

IS : 10000 Part VI Recording of test results

IS : 10000 Part VII Governing tests for constant speed engines and selection of engines for use with electrical generators

IS : 10000 Part VIII Performance tests

IS : 10000 Part IX Endurance tests

IS : 10000 Part X Tests for smoke levels, limits and corrections for smoke levels for variable speed engines

IS : 10000 Part XI Information required with inquiry or order and information supplied by the manufacturer with the engine

IS : 10000 Part XII Test certificates

The standard will be complementary to specifications for performance requirements of different types of engines covered by following standards:

IS : 10001 Specification for performance requirements for constant speed compression ignition (diesel) engines for general purposes (up to 20 kW)

IS : 10002 Specification for performance requirements for constant speed compression ignition (diesel) engines for general purposes (above 20 kW)

IS : 10003 Specification for performance requirements for variable speed compression ignition (diesel) engines for automotive purposes

IS : 10004 Specification for performance requirements for variable speed spark ignition engines for automotive purposes

Spark ignition engines for sprayers and similar applications have been covered by IS : 7347-1974 ' Specification for performance requirements of small size spark ignition engines for sprayers and similar applications '.

Two-stroke spark ignition engines for automotive applications which were earlier covered by IS : 1603 will be covered by a separate specification.

The revised methods of tests covered by IS : 10000 (Part I to Part XII) have been aligned with the current international practices in the field of I.C. engines. These parts are in general agreement with the following ISO standards, issued by the International Organization for Standardization:

a) ISO 3046/I-1975 Reciprocating internal combustion engines — Performance: Part I Standard reference conditions and declarations of power, fuel consumption and lubricating oil consumption

b) ISO 3046/II-1977 Reciprocating internal combustion engines — Performance: Part II Test methods

c) ISO 3046/III-1979 Reciprocating internal combustion engines — Performance: Part III Test measurements

d) ISO 2710-1978 Reciprocating internal combution engines — Vocabulary

IS : 10000 (Part I to Part XII) and IS : 10001, IS : 10002, IS : 10003 and IS : 10004 collectively supersede IS : 1600, IS : 1601, IS : 1602 and IS : 1603.